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MISCELLANEOUS INFORMATION RELATING TO HERBAGE PLANTS

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IMPERIAL AGRICULTURAL BUREAUX

EXECUTIVE COUNCIL,
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STAFF OF THE IMPERIAL BUREAU OF PLANT GENETICS: HERBAGE PLANTS.

Director ... ... Prof. R. G. STAPLEDON, M.B.E., M.A.

Chief Officer ... ... Dr. R. O. WHYTE.

Librarian ... ... Miss G. M. ROSEVEARE.

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I. INTRODUCTION.

LITTLE need be said in the way of introduction to this Bulletin. It will be noted that the publication of miscellaneous abstracts and papers indexed has been discontinued. These are now distributed at regular intervals to workers on herbage problems, who may then request the Bureau for copies of any abstracts listed which may be of particular interest to them. As a result of this rearrangement, the section on Research on Herbage Plants has been extended considerably, an attempt having been made to supply more information of value to Tropical workers than was the case with the first Bulletin.

II. CONFERENCES.

(*a*) SCANDINAVIA.

The Fourth Congress of the Association of Scandinavian Agricultural Research Workers (Nordiske Jordbrugsforskeres Forenings Fjerde Kongres) was held at Helsingfors in July 1929. As the papers are published in Swedish, the Bureau has translated the titles of all papers with a general bearing upon herbage and grassland problems, while those of particular interest have been abstracted.

DORPH-PETERSEN, K. **Hvorledes bevarer de vigtigere Kulturfrøarter Spireevnen ved Opbevaring paa almindelige Frølagre ?** [How do the seeds of the more important species of cultivated plants retain their power of germination when kept in ordinary seed storehouses ?] p. 261.

(1) The water content of the stored seed corresponds to the water content of the air in the storehouse. The storehouse must therefore be dry and airy. During damp weather it should be closely shut ; and, if the outer air is dry, fully opened, especially if the outer air is colder than that of the storehouse. The outer air is correspondingly drier when it is becoming warmed, and therefore has an influence on the stored seed. Under such circumstances a draught through the storehouse is recommended, in order to renew the air between the drying seed and in seed heaps.

(2) The rate of germination, germination ability and water content of the seeds to be stored should be known. If the water content is considerably higher than the figures given in the report for normal " sack dry " seeds, one should ensure, by frequent weighing of some of the sacks stored, possibly by water content estimations of average samples of the seeds in question, that the water content is reduced to the normal figure in order that the seed be

approximately normal when warmth occurs again in spring. If it is feared that water content has not been sufficiently reduced, one may resort to germination tests to see that rate of germination has not been retarded. If this has occurred, the seed should be aired or dried at once, and removed to a drier storeroom. Many are of the opinion that feeling and smelling of seed is enough to show damage, but as a rule at this stage it is too late.

(3) In most storehouses floors and storerooms vary as regards air moisture, and gauges should be installed for testing this. Great care should be taken with regard to storing seed in the moister storerooms, especially if the water content of the seed is above the normal. Investigation showed that the oleaginous seeds of *Brassica* and similar plants preserved germination ability better in the moister storerooms, but infection with mildew usual in these atmospheres should be avoided.

Of the grasses, *Dactylis*, *Lolium* species and *Holcus lanatus* seemed to have suffered less damage on being transferred to a moister spot than, for example, the *Festuca* and *Bromus* species, in which germination under these conditions is very strongly retarded. As regards Leguminosae, most samples depreciated considerably on transference to a moister storeroom. The number of observations made are not sufficient for definite data, and the experience of storekeepers may prove more reliable in this respect.

(4) If it is desired to preserve the germination ability of particularly valuable seed for a long time, it should be dried in order to reduce its water content to half the normal figure, and put at once into an airtight container (acid balloon, "Säureballon," bucket, "Transporteimer," or something similar) and stored in a cool chamber at as near 0° C. as possible.—[Translation of abstract by the author in *Proceedings of the International Seed Testing Association*, No. 11-12, p. 150. Copenhagen, 1930.]

HALLAKORPI, I. A. and others. **Dräneringskommittens förslag till anordnande av grundvattenståndsförsök på ängs- och betesmark.** [The scheme of the Drainage Committee for the arrangement of experiments with reference to the level of subsoil water on meadows and pastures.] p. 737.

The experiments which the Committee propose deal with the following problems :—

(1) The effect of different levels of subsoil water on the quantity and quality of the grass crop. (2) The effect of a sinking of the level of subsoil water on earlier grass vegetation. (3) The significance of damming up the subsoil water for short spaces of time during the growing period.

HANSEN, H. J. **Resultater fra Frøavlsforsøgene i Danmark gennem 20 Aar.** [Results from seed production trials in Denmark during the last 20 years.] p. 210.

Cutting trials with late red clover, carried out to ascertain the significance of cutting of late red clover for seed production, showed that cutting does not generally increase the yield, although there is a possibility of increase if cutting took place earlier. 6·5 lbs. per acre was found to be the best seeding rate for white clover. Cutting trials with white clover showed too much divergence to give results of any value. Sowing trials with cocksfoot showed that a seed rate of 12 lbs. per acre in drills 47 cm. apart, with white clover, gave the best result. Trials with admixture of clover in seed crops of cocksfoot were also carried on. As a nurse crop stiff-strawed early barley is preferred. Cutting of cocksfoot in the autumn reduces the seed yield considerably in the following year.

Sowing of meadow fescue in drills a small distance, e.g., 10-20 cm. apart, has given the best result ; the lower figure is found most suitable. Barley is again preferred as a nurse crop. Cutting in the autumn reduces the yield of seed considerably, but this is balanced by the addition of 80-120 lbs. saltpetre per acre.

Times of harvesting seed crops of grasses were also investigated.

POIJÄRVI, ILMARI. **Ett försök att bestämma timotejhöets och klöverblandat timotejhös foderenhetsvärde direkt med ledning av dess analys.** [An experiment to determine the fodder unit value of timothy hay and of timothy hay mixed with clover directly guided by analysis.] p. 152.

[See Bulletin No. 1. p. 16 for abstract.]

SYLVÉN, NILS. **Om rödklöverns självfertilitet.** [Concerning the self-fertility of red clover.] p. 697.

The author discusses the conflicting results obtained by different workers regarding self-fertility of red clover. In his own experiments it was found that of forty plants belonging to strains of different types, seventeen set normal seed in certain years, notably the dry and sunny summer of 1925. 56·5 per cent. of the descendants of self-sterile plants were more or less self-sterile. Self-pollination in another experiment was carried out by (*a*) rubbing the isolating bags, (*b*) transference of pollen from one flower to another within the same flower head, (*c*) transference of pollen from one flower head to another on the same plant. Seed production was as follows : (*a*) 23·5 per cent., (*b*) 26·7 per cent., (*c*) 77·8 per cent. Self-fertility is of definite practical importance, as it was found that self-fertile plants gave with free flowering a much better seed crop than the assortment of clover plants generally.

SYLVÉN, NILS. **Själv- och korsbefruktning hos timotej och hundäxing.** [Self- and cross-fertilisation in timothy and cocksfoot.] p. 670.

[See Bulletin No. 1. p. 18 for abstract.]

TERÄSVUORI, KAARLO. **Om gräsmarksundersökningar.** [Concerning grassland investigations.] p. 724.

The writer gives an exact description of his method of surveying natural meadows and pastures. It is necessary to have a total surface of 26 by 26 metres, of which, according to the amount of time available, a certain number of plots, each 4 square metres in size, are examined as regards number and height of the component plant species and their stage of development. The plant stands are estimated to within 5 or 10 per cent. accuracy. Three investigation schemes are given with examples from Finland.—[Translation of abstract by v. Rathlef. *Fortschritte der Landwirtschaft*, Vol. V. No. 10, p. 372. 1930.]

TORSSELL, R. **Självsterilitet hos luzern. (Medicago sativa och M. media).** [Self-sterility in lucerne. *Medicago sativa* and *M. media*.] p. 666.

Lucerne flowers not selfed, *i.e.*, not tripped, and then isolated in a bag of parchment or closely woven cloth (with very rare exceptions) failed to set seeds. Flowers isolated under similar conditions but tripped gave favourable results. Among 135 isolated plants from various populations not a single individual was found to be absolutely self-sterile when flowers were tripped. It was found, however, that by cross-pollination as compared with tripping (self-pollination) fertility was greatly increased. In one experiment with so-called *Medicago media* there was a 50 per cent. increase in number of seed pods formed in favour of cross-pollination, while Grimm lucerne under similar treatment gave an increase of 20 per cent. It appeared that when unrelated plants were crossed the resulting progeny only in very exceptional cases resembled that obtained by selfing the same parents. To test the effect of in-breeding on self-sterility 764 flowers selfed on 5 parent plants were compared with 806 selfed flowers on plants of their F_1 progeny. The results show that the 5 parents gave an average of 57·1 flowers fertile and the F_1 progeny 12·6 per cent. ; or a decrease of 44·5 per cent. Another test to compare the fertility of a selected parent with $F_1 : F_2 : F_3$ in-bred progeny showed a rapid decrease in each of the three generations, viz. : taking the fertility of the parent as $100 : F_1 = 35 ; F_2 = 27 ; F_3 = 4$.

W. S.

WALLE, OTTO. **Om självesterilitet hos timotej.** [Concerning self-sterility in timothy.] p. 691.

The author describes in detail the methods employed in isolation of timothy plants. Spatial isolation and parchment isolation were employed, with preference to the latter method. Original plants were used, as

bred material might be enfeebled by self-fertilisation. It was found that although self-sterile individuals do not occur among the original material, the general approach to total self-sterility was very marked. Semi-fertile individuals occurred very rarely with free flowering. Variations in self-sterility in a semi-fertile individual were studied in the first and second isolation generations. Seeds formed with self-fertilisation during three years averaged 127 per inflorescence (13·5 per cm. of inflorescence), while with free flowering, the number of seeds per inflorescence was 1,145 (117·7 per cm. of inflorescence). In the F_1 generation the seeds from self-fertilisation in different individuals varied between 196·5 and 30·8 per inflorescence. All the plants can be regarded as semi-fertile. Seed output and germination after free flowering were about normal. The majority of the individuals in the F_1 generation proved self-sterile, while there was also a reduction in seed setting and seed quality after free flowering. In the F_2 and F_3 generations, the individuals were so weak that they were of little value for breeding.

WEXELSEN, H. **Om grunnlaget for arvelige og ikke arvelige variasjoner i selvsterilitet hos planter.** [Concerning the foundation for hereditary and non-hereditary variations in self-sterility in plants.] p. 649.

Sterility is governed by a series of allelomorphic factors in such a way that the growth of the pollen tube through the style of an individual with the same factors is inhibited. With all so-called self-sterile plants there appear normally several genetically different sterility classes, of which each is intra-sterile but fertile when crossed with another class. Plants of the same fertility class are cross-sterile amongst themselves. In-breeding of a self-sterile plant leads to the production of many plants belonging to the same fertility class, with the result that cross-sterility increases. Self-sterility is governed by a series of external factors, which at times are capable of veiling their influence, so that one can obtain seed from a genotypically self-sterile plant. The age of the flower fertilised, weather conditions and so forth are mentioned amongst other things as the external factors referred to. Bibliography appended.—[Translation of abstract by v. Rathlef. *Fortschritte der Landwirtschaft*, Vol. V. No. 10, p. 373. 1930.]

BONDORFF, K. A. **Forsøg med forskellige Kvælstofgødninger.** [Experiments with different nitrogenous manures.] p. 812.

CHARPENTIER, C. A. G. **Iakttagelser vid betesförsök i Finland.** [Observations on grazing trials in Finland.] p. 764.

ELOFSON, A. **Kunna fordringarna på äggviterikare vinterfoder bättre tillgodoses genom en omläggning av vår vallodling ?** [Can the need for a winter fodder richer in protein be met more satisfactorily by a rearrangement of our ley cultivation ?] p. 744.

FEDERLEY, HARRY. **Nyare rön rörande artbastarder.** [Recent experiences concerning species hybrids.] p. 632.

HELLBO, ERIC. **Den svenska fältkontrollens organisation och arbetsmetoder.** [Organisation and methods of work of the Swedish field control.] p. 248.

KITUNEN, E. **Om torkning av säd.** [Concerning drying of seed.] p. 234.

KRISTENSEN, KR. **Gødningens Indvirkning paa Kulturvæksternes Næringsindhold.** [The influence of manuring on the nutrient content of cultivated plants.] p. 772.

LUND, VIGGO. **Lethal Faktorer i Majs.** [Lethal factors in maize.] p. 604.

RASMUSSON, J. **Letalfaktorer hos ärter.** [Lethal factors in peas.] p. 611.

VIRTANEN, ARTTURI J. **Undersøgelser over Bælgplantebakterierne og Bælgplanterne.** [Investigations on leguminous bacteria and the Leguminosae.] p. 782.

(*b*) SOUTH AFRICA.

Certain subjects of interest to herbage and grassland workers were raised at the Pan-African Agricultural and Veterinary Conference in Pretoria in August, 1929 in addresses published in the form of papers in a collected volume, and included in the Bulletin as abstracts.

PAPER NO. 37.

Fodder Plants. E. P. PHILIPS, M.A., D.Sc., F.R.S., Principal Botanist, Department of Agriculture, Union of South Africa.

A systematic investigation of the native stock-food plants is being commenced at Fauresmith Experimental Station, Orange Free State. Excluding grasses, only about 0·4 per cent. of the total flora has been reported as valuable for stock. It is hoped to increase this percentage considerably. Not more than a dozen species have been chemically analysed, but these show favourable comparison with the ordinary forage crops, especially as regards carbohydrate content. In the great sheep area of the Karroo, where native bushes are very important for fodder, succulent plants are characteristic. Eight species of *Euphorbia*, three species of *Mesembryanthemum* and one species of *Zygophyllum* have been reported as valuable for stock. Results of investigations at Fauresmith are encouraging.

PAPER NO. 38.

Mineral deficiency in South African veld. M. HENRICI, Ph.D., D.Sc., Plant Physiologist, Department of Agriculture, Union of South Africa.

The phosphorus deficiency of vast areas of the South African veld is reflected in the plant life, grasses being poor in phosphorus at all times except in spring, when the young leaves approach European standards. Rains have a marked effect on the phosphorus content of leaves in the late summer, but the spring level is not reached.

It is suggested that phosphorus deficiency is the cause of the very low seed production of many plants, *e.g.*, *Themeda triandra*. Top dressing and irrigation produced a partial increase in certain grasses, *e.g.*, *Eragrostis*, *Cymbopogon* and *Aristida*, but had no effect on *Themeda*. It is remarked that some annuals tend to have a high P_2O_5 content, when perennials are very low. The soil of the area investigated is the poorest in Bechuanaland. Certain areas have rich soil, upon which is a very palatable bush, *Salsola Zeyheri*. The P_2O_5 content of plants other than grasses from the deficient areas tends to be higher, but these plants are not palatable. A good root system is the probable cause of this increase ; grasses in that area have a very small root system.

PAPER NO. 39.

Pasture plants of Africa—Grasses. SYDNEY M. STENT, Agrostologist, Department of Agriculture, Union of South Africa.

The data included in this paper are dealt with in Section IV (*g*) of this Bulletin, Research on herbage plants in South Africa.

PAPER NO. 40.

The effects of burning on the pasturage of natural grasslands, with special reference to South Africa. R. R. STAPLES, M.A., Botanist, School of Agriculture, Cedara, Union of South Africa.

In summarising the results of experiments over the past eight years, the author points out that they probably do not apply to areas with less than 30 in. rainfall. Under higher rainfall conditions, the total elimination of burning is at present impracticable. Winter burning encourages valuable grasses, *e.g.*, *Themeda triandra*, summer burning the inferior. Herbage on burnt grassveld is more suitable for nutrition of stock. Burning checks unfavourable botanical changes, causes extremes in soil temperature and greater loss of moisture, and results in a loss of nitrogen and organic matter to the soil. Burning once in two or three years is suggested as the best procedure.

Paper No. 62.

The pastoral prospects of South West Africa and similar semi-arid areas. P. J. v. d. H. Schreuder, B.A., Ph.D., Chief Agricultural Officer, South West Africa Administration.

One third of this country is desert, one third an arid region with very low rainfall and sparse vegetation, while the majority of the other third has some very fine ranching country. Owing to lack of knowledge it can only be said that it is an area rich in pasture grasses. The pastoral prospects, limiting factors, cattle breeds, and other important questions are dealt with.

Paper No. 63.

Fodder reserves for droughts. M. J. Joubert, B.S.A., Assistant Chief, Division of Plant Industry, and G. S. Maré, B.Sc. (Agric.), Grootfontein School of Agriculture.

This article deals with the conditions of the farmer situated in such areas as the Karroo, with about 12 in. rainfall per annum. The following questions are discussed :—

(1) Veld preservation, (*a*) Fencing, (*b*) Water supply, (*c*) System of farming, (*d*) Soil erosion.
(2) Propagation of drought resistant crops.
(3) Methods of feeding.

Under (2) the relative merits of spineless cactus, saltbush and lucerne are described. The amount of water required for lucerne could be better employed in the cultivation of the other two crops. Prickly pear, fed to sheep as fresh pulp, is stated to allow the sheep to obtain their normal water requirements, and does not affect the wool in any way.

Report of Proceedings. (*Separate volume.*)

p. 268. Dr. Pole Evans raised the question of pasture plants of Africa and the increasing of grazing and watering facilities. A resolution was passed (p. 284) emphasising the desirability of the preparation, by the different Governments and States in Africa, of a list of known grasses and other pasture plants. The Government of South Africa should collect this information and circulate it to all concerned.

III. The Decimal Classification.

The Decimal Classification appears to be the solution of the problem of how to obtain international exchange of information on given subjects. A numerical system, and thus eminently suitable for international purposes, it is based on Melvil Dewey's Decimal Classification and Relativ Index published in 1876. It does not claim to be anything but an arbitrary system of

classification ; it is, however, sufficiently logical to enable it to be readily grasped and applied. The sum total of human knowledge is represented by unity. This is divided into 10 main classes, as follows :—

·1 Philosophy
·2 Religion, Theology
·3 Social Science
·4 Literature
·5 Pure Science
·6 Applied Science, Industries
·7 Fine Arts
·8 Literature
·9 History, Geography

the division ·0 being retained for bibliography and kindred subjects.

Each of these divisions is again sub-divided into main groups ; for example, ·5 has the main sub-divisions (and at this stage the first decimal point, for convenience, is dropped) :—

51 Mathematics
52 Astronomy, Geodesy, Navigation
53 Physics
54 Chemistry, Mineralogy
55 Geology
56 Palaeontology
57 Biology, Anthropology
58 Botany
59 Zoology

These main divisions are sub-divided afresh by the addition of further decimal places, and as is obvious, this process may be extended practically without limits, so that extremely detailed classification is possible. By cross reference different subjects may be correlated, *e.g.*, information on laws governing the production of agricultural seed would be classified under :

340·13 : 631·531·12,

340·13 representing laws and 631·531·12 seed production.

For classifying scientific information the system is found admirably adapted, because its elasticity allows of continual additions being made to the classification as and when additional information is gained on any particular subject. An International Committee with headquarters at Brussels and a very active branch in London, governs the composition of the actual classification tables and all proposed additions thereto in order that uniformity may be ensured.

The practical application of the classification is simple. The reference to the matter to be indexed is typed on an index card, the decimal classification number or numbers being placed at the right-hand top corner. The

example already quoted, information on laws governing the production of agricultural seed, would have as its reference numbers :

340·13 : 631·531·12
631·531·12 : 340·13.

Two cards would be necessary, one bearing in the right-hand top corner :

340·13 : 631·531·12

and the other :

631·531·12 : 340·13.

The arrangement of the cards in the index is in numerical order, with the result that all cards on any given subject automatically group together, and thus an economist studying laws that affect agriculture would find the information he required grouped together under 340·13 whereas a worker interested purely in seed production would find collected under the number 631·531·12 : 340·13 information which might possibly instil a caution otherwise not conceived.

The Decimal Classification has been adopted by the Imperial Bureau of Plant Genetics (Herbage Plants) at Aberystwyth. The main headings under which material is indexed are : Grasses, legumes and miscellaneous forage plants, arranged under genera ; grassland in general ; various related subjects in so far as they affect herbage problems, such as seed production, drought resistance, irrigation, general physiology and ecology ; and poison plants which may occur in pastures.

IV. Research on Herbage Plants.

In this section of the Bulletin it is our object to supply information as recent as possible as to studies upon herbage plant problems which are in progress in various countries. It is not intended to supply a complete account in each case, but merely to include abstracts and notes on special lines of research. As regards parts of the British Empire, it will be understood that the Bureau has further information in the form of replies to Circular Letter No. 1, but as these are still incomplete, the data supplied will not be discussed at this stage.

(*a*) Australia.

Investigations in progress in Australia, as shown by the *Third Annual Report of the Council for Scientific and Industrial Research* (*Year ended* 30th June, 1929) deal with pastures principally in relation to animal nutrition. The Division of Animal Nutrition opened in connection with the University of Adelaide towards the end of 1928 a laboratory which is regarded as the centre of the activities of the Division. The main problem at present being studied is " the utilization and availability of phosphoric acid and of the

particular protein required by the sheep." The deficiency in phosphoric acid of soils in many pastoral districts, and the variation in quality of the feed available at different times of the year, renders this work very important. In addition the study of grasses and other forage plants, especially as regards their protein and cystine value, is in progress. " Wool fibre is a protein of unusual composition containing a high proportion of the sulphur-containing amino-acid cystine " ; this cystine must be made available to the sheep " pre-formed in the proteins of the fodder." (*See Council Bulletins* Nos. 38 and 39.)

At the Waite Agricultural Research Institute, investigations on the mineral deficiencies of pastures are being carried out under the direction of Professor A. E. V. Richardson. A progress report of this work is supplied in the Council's Pamphlet No. 17. The general aim is to study the mineral content of the indigenous pastures upon which practically all the sheep and cattle are maintained, " with a view to determining the grassland areas in which deficiencies exist, and the most economical methods of correcting such deficiencies."

" As to the effect of the stage of growth on the mineral content, it has been found that the absorption of mineral matter and nitrogen is extraordinarily rapid in relation to the amount of water transpired and dry matter synthesized from tillering to flowering." " It has also been found that grasses and clovers produce dry matter at a relatively low water cost during the early stages, but in the final stages the water cost of dry matter is relatively higher. This result, taken in conjunction with the high protein and mineral content of young grass, is of great economic significance in pasture management in some arid areas."

Another study which may be mentioned is that on the regeneration of native vegetation in areas where the annual average rainfall is less than 10 in. The University of Adelaide commenced investigations of this nature on an area of 1,000 acres of eaten-out salt-bush country at Koonamore, N.E. South Australia, the main objects being (*a*) a study of the regeneration of natural vegetation, (*b*) the study of the effect of grazing of known intensity on the process of regeneration, (*c*) the study of the ecology of the area. A full time investigator is now situated on the Reserve, and a description of the work in progress was published in the Council's *Journal*, Vol. I, No. 6.

(*b*) Czechoslovakia.

Chmelar, Fr. and Mikolasek, Fr. **Wachstum und Ertragseigenschaften einiger neuen Zuchtsorten von Rotklee nach Versuchen 1923-1929.** [Growth and yield qualities in some new bred strains of red clover ; trials 1923-1929.] *Bulletin of the Czechoslovak Academy of Agriculture*, Vol. VI. No. 1. Brno., 1930.

In summarising the results hitherto obtained by the improvement of red clover varieties, it is seen that Denmark with its strains Øtofte and Tystofte 40,

and Switzerland, with its varieties of meadow and perennial clover, lead the way ; Germany follows with Lembke and Silesian, Czechoslavakia with Prof. Holy's meadow clover and Dreger's yellow seed clover, then comes Austria with Loosdorf P.R. II ; all these varieties gave a better yield than the unimproved native strains. It is still necessary to test in a greater number of places the bred strains of red clover for winter hardiness, disease resistance, quality and capacity of seed-setting, the strength and depth of root systems, etc.

CHEMLAR, FR. **Aus der Tätigkeit der Sektion für Samenprüfung der Mährischen landw. Landesversuchsanstalt in Brünn im Jahre 1928.** [The work of the Seed Testing Section of the Moravian Agricultural Research Station at Brünn, 1928.] *Verlautbarungen d. deutschen Sektion des Mährischen Landeskulturrates in Brünn*, No. 7. April, 1929.

In the laboratory trials the experiments on the process of germination in hard clover seeds were continued and a report of the results hitherto obtained was published (Dr. Chmelar). The experiments for determining the weight of viable and non-viable seeds and their effect upon seed value were completed and the results published (Dr. Nâdbornik). Numerous and extensive trials were carried out in forage crop cultivation, such as variety trials with red clover, germination trials of hard clover seed in the soil, experiments in grass production, testing clover mixtures, testing of various grass species and varieties (especially bred strains). This work was carried on in fifteen places, including Roznov and Troppau.

(*c*) DENMARK.

FRANDSEN, H. N. **Fra Forsøgsgaardene.** [From the Experiment Farms.] **III. Nya kløverstammer.** [New strains of clover.] *Tidsskrift for Frøavl*, Vol. XVIII. No. 212. p. 396. Roskilde, 1930.

At Øtoftegaard in recent years work has been carried on with red clover, alsike and white clover, at Roskilde with *Medicago lupulina* and *Anthyllis vulneraria*. Good conclusive results have already been obtained in some of the work. A very important branch in breeding work is the large field trial to ascertain the productivity of the different strains and families. On this basis the final selection is undertaken. In 1915, breeding work was commenced at Vintapper near Lyngby with a sample of late red clover from the vicinity of Horsens. The work was continued at Øtoftegaard with the result that a new strain, sold as " Øtofte late, " was produced. Tests from 1922-24 showed it to give the highest yield in both harvest years. In 1918, breeding was commenced with Hersnap red clover at Øtoftegaard ; from this work was produced a new strain, " Øtofte semi-late." This is a quite early-flowering late clover, high yielding and persistent.

(*d*) Finland.

Walle, Otto. **Ueber die Wachstumsverhältnisse von finnischen und ausländischem Weissklee.** [On the growth of Finnish and foreign white clover.] *Tammisto, Siemenjulkaisu*, p. 194. Helsinki, 1930.

The Tammisto Plant Breeding Station has been endeavouring since 1925, when the breeding of white clover was first started, to perpetuate the characters of the Finnish white clover. For purposes of comparison foreign and in particular Danish material was examined. Certain results of the trials are tabulated. They concern hard-seededness, winter-hardiness, flowering time, extent and height of growth, yield data and after-growth.

Walle, Otto. **Resultate von Sortenanbauversuche 1925-29.** [Results of variety trials.] *Tammisto, Siemenjulkaisu*, p. 64. Helsinki, 1930.

The results of variety trials carried out at Tammisto from 1925-1929 are given in the tables included in the main paper. The elimination of systematic soil error was accomplished by Christensen's method. In the timothy trials it was found that the Swedish bred strains (Gloria, Freya) could not compare as regards yield with the Finnish unbred strains. In the same way the Finnish red clover strains, because they wintered better, gave on the whole better yields than certain Swedish bred strains (Svalöf's Improved Late Clover, Östgöta) ; and the red clover "Øtofte sildig," which under Danish conditions is very winter-hardy, was the least winter-hardy of all the foreign bred strains tested here.

(*e*) India.

Bombay Presidency.

The Annual Report of the Department of Agriculture for the year 1928-29 contains reference to certain matters of herbage interest. Mr. V. V. Godgil reports (p. 147) on the suggestion to remove " all the milch cattle from Bombay to some nearest centre of grass areas," the object being to organise a dairy district. A special graduate has been appointed to collect information from the grass area of Palghar Taluka, especially as regards " availability of the grass and other facilities such as supply of water, vicinity of railway lines, etc." " If the dairy district be organised, it will do an immense benefit to the people of Bombay, and save slaughter of nearly 20,000 best milk cattle and an equal number of heifers annually."

Mr. A. R. Gulmahomed gives some notes on miscellaneous forage crops in Sind. " Two popular leguminous crops of the Rabi season are gram and matar " (*Cicer* and *Pisum*). These crops are apparently adversely affected by frost. Grazing of gram by cattle just prior to the frost caused this crop to escape injury, " with the result that the average yield was 343 and 402 lbs. per acre from Pusa White and Local Red variety respectively." Berseem (*Trifolium Alexandrinum*) is of importance under irrigation, "for it provides

nutritious fodder at a time when there is a dearth of good fodder (viz., December to June)." It is also a " very powerful recuperator," and is in Egypt " considered to be the key to the cultivation of alkaline lands." The cold wave reduced the average yield of green fodder per acre to 28,822 lbs. at Sukkur and to 12,330 lbs. at Larkana. At the Willingdon Cattle Farm it was 75,103 lbs. per acre. It is stated by the writer that, although the area at Hyderabad is yearly on the increase, real progress in the cultivation of the crop cannot be achieved unless the seed is produced locally (5,680 lbs. were imported from Egypt during the year). Seed formation in berseem is apparently better in Upper than in Lower Sind. Yields at Sukkur and Larkana vary from 145-207 lbs. of seed per acre.

Another fodder mentioned by the writer is elephant grass (*Pennisetum purpureum*), which is being grown on a small scale at Willingdon and Sukkur.

Professor V. G. Gokhale states that 180 acres at the Poona Agricultural College are under fodder crops. " Lucerne shows a falling off in average yield per acre by about one-third over that of last year on account of a large area being brought under cultivation from the mid-year."

The Economic Botanist, Mr. W. Burns, reports breeding work in progress on bajri (*Pennisetum typhoideum*). Of the seven promising varieties on trial, two have given consistently good results over two years when tested by the " chessboard " method. The difficulty is that these high-yielding varieties are not markedly different in *appearance* from the ordinary crop. The aim of the work is now the breeding of colour into the stems of one or more of the varieties. This writer also deals with the grassland research, stating measures necessary in the district to improve poor grassland, and discussing manufacture of silage, rotational grazing, dry grass production, etc.

PUNJAB.

" The mainstay of Punjab agriculture is wheat," but a very important crop, which is of more value than barley, and which does not suffer from over-production and overseas competition to the same extent as wheat, is gram (*Cicer*). [Report of the *Department of Agriculture, Punjab.* Year ending 30th June, 1929. Part 1. pp. 4-5.] It is suggested that more attention might be paid to this crop.

Tests with fourteen indigenous pasture grasses were continued (p. 31). " Yields were low, but anjan (*Pennisetum cenchroides*) maintained its superiority in point of yield," khawi (*Andropogon iwarancusa*) being the only other grass that approached it. Three cultivated grasses, elephant grass (*Pennisetum purpureum*), Guinea grass (*Panicum maximum*) and Rhodes grass (*Chloris gayana*) were under trial. Drought during summer and frosts during winter were causes of reduced yield. Plants of different habits among the Rhodes grass specimens have been separated and will be studied to discover if they are suited to special localities. Elephant grass has given good results as a tall-growing, heavy yielding grass, although admittedly coarse and inferior

in quality to many other fodders. Sudan grass (*Andropogon sorghum* var. *Sudanensis*) was found to be more resistant to cold and more immune to stem borer than Imphee Jowar (*A. sorghum* var. *Saccharatum*). Farmers favour it, usually obtaining two to four cuttings of fodder.

Seven imported varieties of cowpeas (*Vigna sinensis*) were tested and found to give good yields. They are regarded as a very promising crop. Lucerne trials were carried out with six varieties, eight cuttings being obtained in all cases. " Chinese " and " Tamworth," both from South Africa, were superior varieties. Certain other leguminous fodders, namely berseem, shaftal (*Trifolium resupinatum*), senji (*Melilotus parviflora*) and metha (*Trigonella foenum-graecum*) were tested, and with berseem at the top, gave yields in the order named. Bacteriological tests with inoculated and non-inoculated berseem seed gave results strongly in favour of inoculation, the yield of green fodder being greatly increased.

Seed germination tests were made from various samples. Senji (*Melilotus*) generally ranged from 35-59 per cent. with a low figure from a bazar sample (19 per cent.). Bazar seeds were invariably found defective. Some samples of shaftal, berseem and lucerne were very good (85-98 per cent.), both in samples from Government Farms and the bazar.

Digestibility trials were carried out on cotton seed, maize, oats and grass hay, this last containing a mixture of anjan (*Cenchrus biflorus*) and khabal (*Cynodon dactylon*). The grass hay mixture, one of several tested, was the only fodder of this type which was found to constitute a maintenance ration.

Pusa Agricultural Research Institute. [Bihar and Orissa.]

The report of the Physiological Chemist (Mr. F. J. Warth, M.Sc.) contains reference to Indian fodders and pasture grasses, but this work deals rather with the animal nutrition side of the question, concerning especially digestion experiments and the determination of the mineral constituents of pastures under various typical conditions. Mr. A. Viswanatha Iyer is in charge of this last study.

The Imperial Agriculturist, Mr. Wynne Sayer, B.A., reports on the cultivation of berseem under irrigation. Two crops of green fodder are raised from the area in question each year ; berseem in the cold weather, followed by maize sown with a pulse (*e.g.*, meth, *Phaseolus aconitifolius*). Berseem sowing was started on October 1st and continued until the middle of November, the seed rate varying from 26 to 30 lbs. per acre.

The Imperial Economic Botanist (F. J. F. Shaw, D.Sc., A.R.C.S., F.L.S.) describes extensive breeding work on gram, the chick pea (*Cicer arietinum* L.). The isolation of unit species, several of which promise to be heavy yielders, has been completed. An apparent case of gigantism has arisen in one type, suggesting the necessity for a cytological investigation. The inheritance of seed colour shows that this is due to the segregation and interaction of four factors, a new seed colour, orange, appearing as the recessive. The study of

the recessive phenotype in the F_3 generation was made with the result that in the F_4 generation all plants with orange seed colour in F_3 plants bred true for this character. " Orange and not white is therefore the fundamental colour in grain seeds." With the exception of certain cases where fawn-seeded white flowered plants gave plants with seeds of all four colours, combined with white flowers, it has been found that " red seed colour is correlated with red flower colour, and white, fawn and orange seeds are correlated with white flower colour." In the studies on flower colour, it was found that " the vegetative colour of the stem is an index to the genotypic condition of the flower colour."

Quantitative characters, such as " size of leaflets, petals, pods and seeds, single plant yields, percentage of one, two, or more seeded pods," are being studied, while their relationship with the qualitative characters is being investigated.

The unit species of the cowpea (*Vigna catiang* Endl.) are under investigation by a former student of the Institute, who is at present engaged on completing the work.

Isolation of unit species in rahar (*Cajanus indicus*) has been completed, the 107 types showing great variation in height, habit, time of maturity, flower colour, pod colour and shape, and size, colour and shape of seed. Flower colour and characters of seed and pod are of taxonomic importance, height, habit and time of maturity are of economic importance. The genetics of flower colour are described. A high degree of resistance to wilt (*Fusarium vasinfectum*) has been developed ; the resistant type is also a high yielder. Varietal yield tests have been carried out. *Cajanus* is generally sown mixed with maize ; the latter is harvested in October, leaving the *Cajanus* to grow on during the cold weather.

The seed yield and the yield of green fodder of the kharif pulses (*Glycine, Phaseolus, Cyamopsis,* velvet bean and cowpeas) are tabulated on pp. 91-92.

(*f*) Russia.

Chitrowo, W. N. [**The climate of Siberia and winter-hardy races of Trifolium pratense.**] *Iswest. Sew. -tschernos. Obl. S.-Ch. Opytn. Stanz.* Orel, 1928. 2.

In breeding experiments with *Trifolium pratense* at the Muratow Station in the Orel Province a winter-hardy and drought resistant form with a high seed yield was evolved. It was not, however, sufficiently resistant for the climate of the Orel Province, and upon the instance of P. Lissizyn a trial of Siberian races was begun which might eventually provide material for hybridisation. As a theoretical basis the temperature curves for eight points of the area studied were combined ; all the points lay between 51° and 53° lat., the most westerly at Orel near Moscow, the most easterly, 70° long. distant,

at Werchneudinsk and Bargusin (behind the Baikal Lake). The curves represent the daily maxima and minima of the temperature for a period of three years. Although there was a striking correspondence between the individual years, the eight parallel " amplitude ribbon curves " (Amplituden-Bandkurven) showed a distinct type difference between Orel and the others ; Orel is only in summer decidedly continental, in winter there are marked deviations in temperature and snow covering, and it is these factors which prove injurious to red clover.

Journeys to Siberia undertaken in 1925 and 1926 made it possible to check the red clover district report published by W. A. Kusnezov in 1926. The original Siberian area extends from the base of the Northern Ural in a triangle as far as the upper reaches of the Lena, the broadest part of the triangle passing along the line Perm, Tomsk, Jenisseisk and Upper Tunguska ; at Kasatschinsk in Jenissei district a very winter-hardy and strikingly long-lived (12 years) form was found, which is to be used for hybridisation at the Muratow Station. The eastern part of the red clover area around the Baikal Lake is distinctly secondary and the spread of red clover here is caused by human agency.—[Translation of abstract by Selma Ruoff. *Botanisches Centralblatt*, Vol. XVI. (n.s.) 9/10. p. 281. 1930.]

Pissarev, V. **Fortschritte auf dem Gebiete der angewandten Botanik und Pflanzenzüchtung in der Union der Sozialistischen Sowjetrepubliken während der Letzten zehn Jahre.** [Progress in the sphere of applied botany and plant breeding in the U.S.S.R. during the last ten years.] *Zeitschrift für Pflanzenzüchtung*, Vol. XIV. p. 175. Berlin, 1929.

Central Industrial Region.—

The technique of cultivation of perennial grasses for seed production is studied at the Krassnosorskaja Station for Breeding Fodder Grasses. Breeding work is carried on with clover species, especially red clover, collected during expeditions in the area covered by the station. The common grasses are investigated. Great importance is attached to the individual species and to their botanical description as affected by their geographical and ecological derivation. Self-fertility and self-sterility are studied. Continued selection with forced self-pollination is adopted. Numerous station-bred strains have reached the seed production stage, *e.g.*, types of *Festuca pratensis*, *F. rubra*, *F. arundinacea*, ryegrass, timothy, *Dactylis*, *Alopecurus*, *Lotus corniculatus* and " Konischtschewsky " red clover.

Western Region.

Green manure plants (lupin, serradella) are of importance in the sandy soils of this region, and are studied at the Nowosybkow Experiment Station. Early ripening and yield of green bulk are important as regards the extension of the cultivation area northwards.

URAL REGION.—

The breeding of beans, lentils and red clover is in progress at the Perm Experiment Station. Lucerne is also bred for increased winter hardiness and bulk.

NORTHERN BLACK SOIL REGION.—

At the Schatilow Plant Breeding Station (Director : Dr. P. I. Lissitzyn) work is carried on with clover, *Vicia*, lucerne and fodder beet. It is claimed that winter-hardiness and yielding capacity of red clover are dependent on the time of flowering and the structure of the plant (number of internodes).

UPPER VOLGA REGION.—

The Kasan Agricultural Experiment Station has produced for distribution a strain of clover and a variety (" Tartareihybride ") of lucerne. The severe winter of the district makes cold-resistance an important factor.

LOWER VOLGA REGION.—

Professor W. S. Bogdan introduced the cultivation of *Agropyron cristatum* at the Krassnokutskaja Experiment Station (Dr. P. N. Konstantinov, Director). A hybrid lucerne, drought-resistant and winter-hardy, but with tender and abundant green bulk, has been produced.

CENTRAL BLACK COUNTRY DISTRICT.—

Breeding work is carried on with timothy, *Festuca pratensis, F. rubra, Dactylis, Bromus inermis, B. erectus*, red clover and lucerne at the Marussinskaja Lugowaja Station (Dr. W. P. Struve). Two cut clover is not sufficiently winter-hardy for this area.

WEST SIBERIAN REGION.—

At the West Siberian Experiment Station leafy upright forms (*erecta*) of indigenous *Medicago falcata* have been selected. A productive winter-hardy variety of *Medicago sativa* has been selected and multiplied.

CENTRAL SIBERIAN REGION.—

Even the northern clover varieties suffer from the cold of the forest steppes ; the most suitable legumes are the indigenous wild *Medicago falcata* and *Onobrychis*.

EAST SIBERIAN REGION.—

Selections from Grimm lucerne and growing on with a series of mass selections were carried out.

(*g*) SOUTH AFRICA.

PAPER NO 39—

read at the Pan-African Conference at Pretoria (cf. p. 8) gives an excellent impression of the detailed study of grassland veld in progress in South Africa.

Pasture plants of Africa—Grasses. SYDNEY M. STENT, Agrostologist, Department of Agriculture, Union of South Africa.

The problems awaiting solution in South Africa are grouped under five heads :—

1. Veld deterioration, its causes and effect.
2. Veld improvement.
3. Investigation into the individual value of the most promising indigenous grasses as regards possible cultivation as hay or pasture plants.
4. Introduction of exotic grasses from other parts of Africa for hay or permanent pasture under South African conditions.
5. Treatment of permanent pasture.—
   (*a*) under irrigation or naturally moist conditions ;
   (*b*) under dryland conditions.

The Division of Plant Industry has organised a plan of campaign for the whole Union, with workers co-operating to ensure co-ordination and continuity, and is making an attempt to carry out work along these lines in conjunction with the Agricultural Schools.

POTCHEFSTROOM SCHOOL OF AGRICULTURE.—

Two experiments are in progress : (1) veld management, the object being to study the effect of different methods of grazing and of burning on more or less typical grassveld of the Western Transvaal ; (2) veld renovation, the object being to find the best means of renovating worn-out or " steekgras " veld. No conclusions can yet be drawn.

CEDARA SCHOOL OF AGRICULTURE, NATAL.—

Mr. R. R. Staples, who is engaged almost entirely on pasture investigations, is studying the following questions, with special reference to Natal and Zululand :—

1. Effect on *natural* pastures of (*a*) burning, (*b*) grazing and mowing, (*c*) top-dressing with different fertilisers, and (*d*) frequency of clipping on the yield and composition of fertilised and non-fertilised pastures.

2. *Cultivated* pastures, their establishment and economic value in Natal, and the effect of frequency of clipping on *Paspalum* pasture.

GLEN, ORANGE FREE STATE.—

Mr. J. Morris has experiments in hand with the following objects : (1) To test means of regeneration. (2) To observe effect of treatment on character and intensity of vegetation. (3) To demonstrate the effect of seasonal or rotation grazing.

GROOTFONTEIN—MIDDELBURG, C.P.—

Experiments are under the supervision of Mr. G. A. Gill, Botanist, and Dr. Turpin, Technical Assistant to Division of Plant Industry. Plots of

winter perennial grasses, 22 by 5 yards in size, with the following pastures have been laid down in duplicate :—

(1) Lucerne, (2) Crimson clover, (3) Dutch white clover, (4) *Plantago lanceolata*, (5) Sheep's burnet, (6) Rescue grass, (7) Tall oat grass, (8) Italian ryegrass, (9) New Zealand tall fescue, (10) *Phalaris bulbosa*, (11) Cocksfoot. Results are not yet available.

Manurial and grazing experiments are also in progress, while various pasture experiments such as comparison of veld and cultivated grasses, and grazing experiments on cultivated grasses, spineless cactus, saltbush and lucerne are also being carried out.

Pretoria Division of Plant Industry.—

Mr. J. A. Pentz is in charge at the Drylands Station, Groenkloof and Prinshof. At Groenkloof, there is no water, difficulty being experienced in obtaining enough for the animals on the grazing experiments. Grasses being investigated include woolly finger (*Digitaria*), Limpopo grass (*Echinochloa pyramidalis*), Guinea or buffalo grass (*Panicum maximum*), Rhodes grass, Kikuyu, antelope grass, dryland grass (*Pennisetum cenchroides*), and numerous others of a similar nature, varying to some extent as regards their value for hay and pasture grasses. At Prinshof, small nursery and demonstration plots of all indigenous grasses of South Africa are in project. Acclimatisation of imported grasses, clovers, etc., testing under irrigation, and fertiliser experiments are in progress. Seed collection is also dealt with, strains which seed regularly being established by breeding. Finally the carrying capacity as regards sheep grazing is tested under dryland and irrigated conditions.

V. CURRENT LITERATURE.

(*a*) Papers Abstracted.

As was noted in the introduction to this Bulletin, a list of papers of herbage interest which have been abstracted is not now published in the Bulletin, but is distributed at regular intervals to all on the mailing list.

(*b*) Recent Book Publications.

Aereboe, F., Hansen, J., and Roemer, Th. **Handbuch der Landwirtschaft.** [Handbook of agriculture.] Pub. Paul Parey, Berlin, 1930. Five volumes, of which **Vol. III, Pflanzenbaulehre, Landmaschinen**. [The science of crop production. Agricultural machines.] By Th. Roemer and K. Vormfelde, is of interest. Price of the five volumes : £9 2s. The work is also obtainable in 25 parts : 6s. each.

Bernstein, Felix. **Variations- und Erblichkeitsstatistik.** [The statistics and variation of heredity.] Pub. Gebr. Borntraeger, Berlin, 1929. Price 14s. Reviewed in *Nature*, Vol. CXXVI, No. 3166, p. 4, 1930.

BOLHOEFER, A. **Betriebswirtschaftliche Untersuchungen über die Grünlandwirtschaft im Freistaat Lippe.** [Investigations on grassland management in Lippe.] Pub. Halle, 1930. Price 4s.

BORNEMANN, F. **Die Kohlenstoff-Ernährung der Kulturpflanzen.** [The carbon nutrition of cultivated plants.] Pub. Paul Parey, Berlin, 1930. Price 2s. 3d. Reviewed in *Angewandte Botanik*, Vol. XII, No. 3, p. 237. 1930.

BRANDT, JOACHIM. **Binsen und ihre Bekämpfung auf Wiesen und Weiden.** [Rushes in meadows and pastures and their control.] Pub. J. Neumann, Neudamm, 1930. Price 3s.

BRIEGER, FRIEDRICH. **Selbststerilität und Kreuzungssterilität.** [Self-sterility and cross-sterility.] Pub. Berlin, 1930. Price £1 14s.

FISCHER, WALTHER. **Samengewinnung und Saatgutbereitung bei den wichtigsten Klee- und Grasarten.** [Seed production and seed preparation in the most important clover and grass varieties.] Pub. Oscar Schlegel, Berlin, 1928. Price £2 5s.

FISHER, R. A. **The genetical theory of natural selection.** Pub. Oxford, 1930. Price 17s. 6d.

FRECKMANN, W. **Die Kultur der Niederungsmoore.** [The cultivation of low-lying moorland.] Pub. 1930. Price 4s. 6d.

FRUWIRTH, C. **Allgemeine Züchtungslehre der landwirtschaftlichen Kulturpflanzen.** [General science of the breeding of agricultural crop plants.] 7th, revised edition. Pub. Paul Parey, Berlin, 1930. Price £1 5s.

HENNING, ERNST. **Bestimmungstabellen für Gräser und Hülsenfrüchte im blütenlosen Zustande.** [Identification tables for grasses and leguminous plants when not in flower.] Pub. Julius Springer, Berlin, 1930. Price 3s.

KOCH, H. **Die Ertragsermittlung im Weidebetriebe.** [Estimation of yield in pasture management.] Pub. 1929. Price 7s. 6d.

LOEHNER, LEOPOLD. **Die Inzucht.** [Inbreeding.] No. 15 of Naturwissenschaft u. Landwirtschaft. Reviewed in *Botanisches Archiv*, Vol. XXIX, No. 3/4, p. 538. Pub. Munich, 1930. Price 9s. 6d.

MAXIMOV, N. A. **The plant in relation to water. A study of the physiological basis of drought resistance.** Pub. Allen and Unwin, London, 1929. Price £1 1s.

MITSCHERLICH, E. A. **Zur Ausschaltung eines systematischen Fehlers bei Feldversuchen.** [The elimination of systematic error in field trials.] Pub. 1929. Price 2s. 6d.

MOELLER-ARNOLD, E. and FEICHTINGER, E. **Der Feldversuch in der Praxis.** [The field trial in practice.] Pub. Vienna, 1929.

MUENCH, ERNST. **Die Stoffbewegungen in der Pflanze.** [Movements of matter in the plant.] Pub. Gustav Fischer, Jena, 1930. Price 12s.

NIGGL, LUDWIG. **Das Grünland in der neuzeitlichen Landwirtschaft.** [Grassland in modern agriculture.] 3rd, revised edition. Pub. Paul Parey, Berlin, 1930. Price 4s.

OLDERSHAW, A. W. and PORTER, JOHN. **British Farm Crops.** Pub. Ernest Benn, Ltd., 1929. Price 12s. 6d. Reviewed in *Bulletin of Imperial Institute*, Vol. XXVIII, No. 2, p. 252. 1930.

ORWIN, C. S. **The reclamation of Exmoor Forest.** Pub. Humphrey Milford, London, 1929. Price 10s. 6d.

PRJANISCHNIKOW, D. N. **Spezieller Pflanzenbau: der Anbau der landwirtschaftlichen Kulturpflanzen.** [Agricultural crop production.] Part IV. Fodder crops. Pub. Springer, Berlin, 1930. Price £2 17s. Reviewed in *Journal of Botany*, Vol. LXVIII, No. 809, p. 158. 1930.

ROEMER, THEODOR. **Der Feldversuch. Eine kritische Studie auf naturwissenschaftlich- matematischer Grundlage.** [The field trial. A critical study from a scientific and mathematical point of view.] 3rd edition. Pub. Berlin, 1930. Price 8s.

WEAVER, JOHN E. and CLEMENTS, FREDERIC E. **Plant ecology.** Pub. New York, 1929. Price 25s. Reviewed in *Annals of Applied Biology*, Vol. XVII, No. 2, p. 398. 1930.

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